

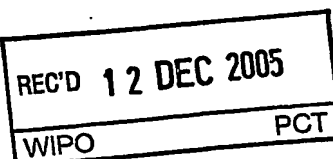
# PATENT COOPERATION TREATY


## PCT

### INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)



Applicant's or agent's file reference PCT 2323 NN904gar		<b>FOR FURTHER ACTION</b>		See Form PCT/PEA416
International application No. PCT/JP2004/010982		International filing date (day/month/year) 26.07.2004		Priority date (day/month/year) 09.10.2003
International Patent Classification (IPC) or national classification and IPC H02M7/5387, H02P6/08, H02P6/10, H02P6/06				
Applicant MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD. et al.				
<p>1. This report is the International preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau a total of 3 sheets, as follows:</p> <p><input type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>				
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>				
Date of submission of the demand  05.07.2005		Date of completion of this report  09.12.2005		
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized Officer  Kanelis, K  Telephone No. +49 89 2399-7558		



**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/JP2004/010982

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**Box No. I Basis of the report**

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1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
- ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
- ☐ international search (under Rules 12.3 and 23.1(b))
  - ☐ publication of the international application (under Rule 12.4)
  - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report):*

**Description, Pages**

1-16 as originally filed

**Claims, Numbers**

1-8 received on 05.07.2005 with letter of 05.07.2005

**Drawings, Sheets**

1/24-24/24 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☐ The amendments have resulted in the cancellation of:
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
- ☐ the description, pages
  - ☐ the claims, Nos.
  - ☐ the drawings, sheets/figs
  - ☐ the sequence listing (*specify*):
  - ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**

International application No.  
PCT/JP2004/010982

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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1. Statement

Novelty (N)	Yes: Claims	1-8
	No: Claims	-
Inventive step (IS)	Yes: Claims	1-8
	No: Claims	-
Industrial applicability (IA)	Yes: Claims	1-8
	No: Claims	-

2. Citations and explanations (Rule 70.7):

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
REPORT ON PATENTABILITY  
(SEPARATE SHEET)**

International application No.

PCT/JP2004/010982

1). Following documents are referred to:

D1: US4832576

D2: US6194856

D3: US2001035018

D4: EP0868017

D5: JP2000069784

2). Old claim 7, which derived the current reference signal from the actual rpm value, was dependent on old claims 1 or 2. Thus, the applicant acknowledged, that the speed feature belongs to a dependent claim. Now this feature formed a new independent claim 2. But the independent device claims 1 and 2 still refer to the control of an inverter-fed brushless DC motor with flux and position sensors and do not describe inter-related products or alternative solutions on how to control inverter and motor voltages according to the position sensor signals, which, certainly, deliver a speed signal, on which a current controller is working. Thus it is recommended to draft a single independent device claim followed by appropriate dependent claims to fulfill Art. 6 PCT.

3). D1, which is considered as the closest prior art, discloses a

- brushless DC motor coupled directly to an AC source, the motor comprising:
- a stator (30) in fig. 2 including a stator coil;
- a rotor (32) including a rotor magnet;
- a position sensor (44) for sensing the rotor position (col. 3, lines 21-44);
- an inverter circuit (90) including a plurality of switching elements coupled in a full-wave bridge having an upper arm and a lower arm (fig. 6 and col. 7, lines 49-56);
- an AC source coupler (110) in fig. 4 or 9 (col. 6, lines 38-46);
- a rectifier (112) for full-wave rectifying a voltage of the AC source (col. 6, lines 47-50);
- a DC voltage converter (98) for converting a rectified voltage applied from the rectifier into a flat and low DC voltage, and for applying the flat and low voltage to the inverter circuit as a power supply (fig. 10, col. 12, lines 7-12); and
- a controller (82) for controlling the inverter circuit based on a signal supplied from the magnetic flux sensor such that the low DC voltage is supplied to the stator coil in a full-wave driving method (fig. 3 and 5, col. 8, lines 35-57).

4). Differences between Claim 1 and D1:

- a magnetic flux sensor for sensing a distribution of magnetic flux density of the rotor magnet;
- a current controller for regulating an average current value applied to the inverter circuit constantly at a set current;
- wherein the set current changer changes the set current regulated by the current controller in response to which terminals of the AC source couplers are coupled to the AC source.

- 5). D1 operates the BLDC motor in a conventional manner based on signals of the Hall sensors. Thus, the skilled person, trying to generate current reference waveforms will have no reason to insert magnetic flux sensing coils into the motor, which are expensive and get noises from the airgap, to get the real back-EMF and to generate set values for the phase currents. He would only apply look-up tables as proposed in D4. Since only a speed control is realised in D1 for a ventilator operated at a given voltage, it is not necessary in this application to adapt the reference current to the mains voltage. Thus, claim 1 is new and inventive (Art. 54 and 56 EPC).
- 6). Claims 2-8 define details of the voltage adjustment and current control and are therefore also new and inventive (Art. 54 and 56 EPC).

Our Draft Amendments

The following new claims 1-8 replace all original claims.

1. A brushless DC motor coupled directly to an AC source, the motor comprising:

- (a) a stator including a stator coil;
- (b) a rotor including a rotor magnet;
- (c) a magnetic flux sensor for sensing magnetic flux of the rotor magnet;

- (d) an inverter circuit including a plurality of switching elements coupled in a full-wave bridge having an upper arm and a lower arm;

- (e) a plurality of AC source couplers;
- (f) a rectifier for full-wave rectifying a voltage of the AC source;

- (g) a DC voltage converter for converting a rectified voltage supplied from the rectifier into a low DC voltage, and for applying the low DC voltage to the inverter circuit as a power supply;

- (h) a controller for controlling the inverter circuit based on a signal supplied from the magnetic flux sensor such that the low DC voltage is supplied to the stator coil in a full-wave driving method; and

- (i) a current controller for regulating an average current value applied to the inverter circuit constantly at a set current;

- (j) a set current changer for changing the set current regulated by the current controller;

wherein the set current changer changes the set current regulated by the current controller in response to which terminals of the AC source couplers are coupled to the AC source.

2. A brushless DC motor coupled directly to an AC source, the motor comprising:

- (a) a stator including a stator coil;
- (b) a rotor including a rotor magnet;
- (c) a magnetic flux sensor for sensing magnetic flux of the rotor magnet;

(d) an inverter circuit including a plurality of switching elements coupled in a full-wave bridge having an upper arm and a lower arm;

(e) an AC source coupler;

(f) a rectifier for full-wave rectifying a voltage of the AC source;

(g) a DC voltage converter for converting a rectified voltage supplied from the rectifier into a low DC voltage, and for applying the low DC voltage to the inverter circuit as a power supply;

(h) a controller for controlling the inverter circuit based on a signal supplied from the magnetic flux sensor such that the low DC voltage is supplied to the stator coil in a full-wave driving method;

(i) a current instructing means for instructing the average current value for supplying to the inverter circuit;

(j) a current controller for regulating the average current value supplied to the inverter circuit constantly at a instructed value; and

(k) an output means for outputting a signal of a motor rpm based on a signal supplied from the magnetic flux sensor;

wherein the current instructing means instructs the average current value for supplying to the inverter circuit in response to the motor rpm.

3. The brushless DC motor of claim 2, wherein the AC source coupler includes a plurality of terminals,

wherein the current instructing means changes an instruction of the average current value in response to the motor rpm depending on which terminals of the AC source coupler are coupled to the AC source.

4. The brushless DC motor of claim 2, further comprising:

a detecting means for detecting a rpm range of the motor within which the motor rpm is included,

wherein the current instructing means instructs the average current value for supplying to the inverter circuit in response to the rpm range of the motor.

5. The brushless DC motor of claim 1 further comprising:

a current instructing means for instructing an average current value to the inverter circuit; and

a terminal for connecting a voltage reducing means disposed outside the motor,

wherein a signal voltage which instructs the average current value to the inverter circuit is applied to the current instructing means via the voltage reducing means disposed outside the motor and

wherein the signal voltage instructs the inverter circuit to run a constant current.

6. The brushless DC motor of claim 2 further comprising:

a terminal for connecting a voltage reducing means disposed outside the motor,

wherein a signal voltage which instructs the average current value to the inverter circuit is applied to the current instructing means via the voltage reducing means disposed outside the motor and

wherein the signal voltage instructs the inverter circuit to change a current in response to the motor rpm.

7. The brushless DC motor of claim 4 further comprising:

a terminal for connecting a voltage reducing means disposed outside the motor,

wherein a signal voltage which instructs the average current value to the inverter circuit is applied to the current instructing means via the voltage reducing means disposed outside the motor and

wherein the signal voltage instructs the inverter circuit to change a current in response to the rpm range of the motor.

8. An electric apparatus in which the brushless DC motor as defined in claim 1 or claim 2 is mounted.